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PATENT & TRADEMARK OFFICE

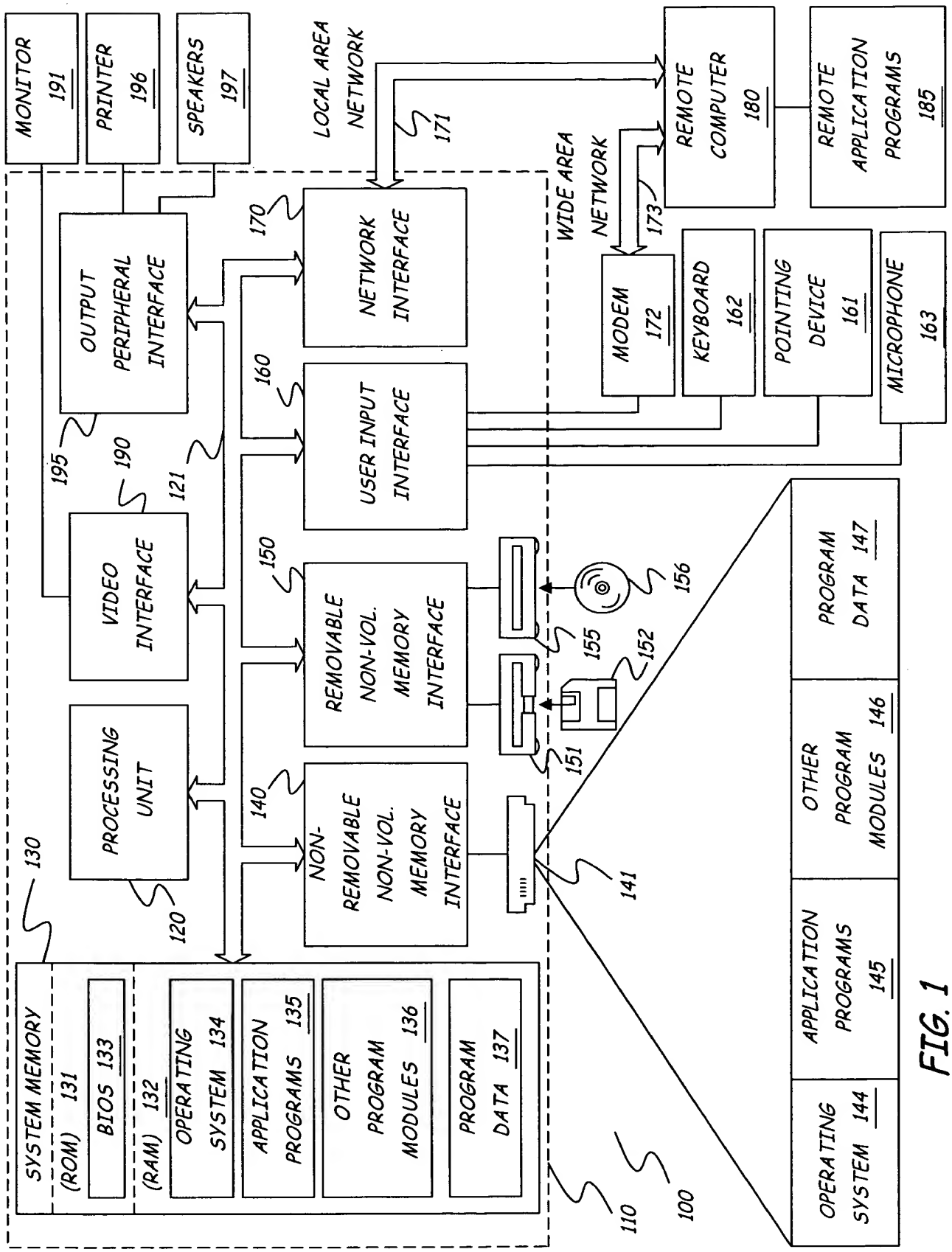


FIG. 1

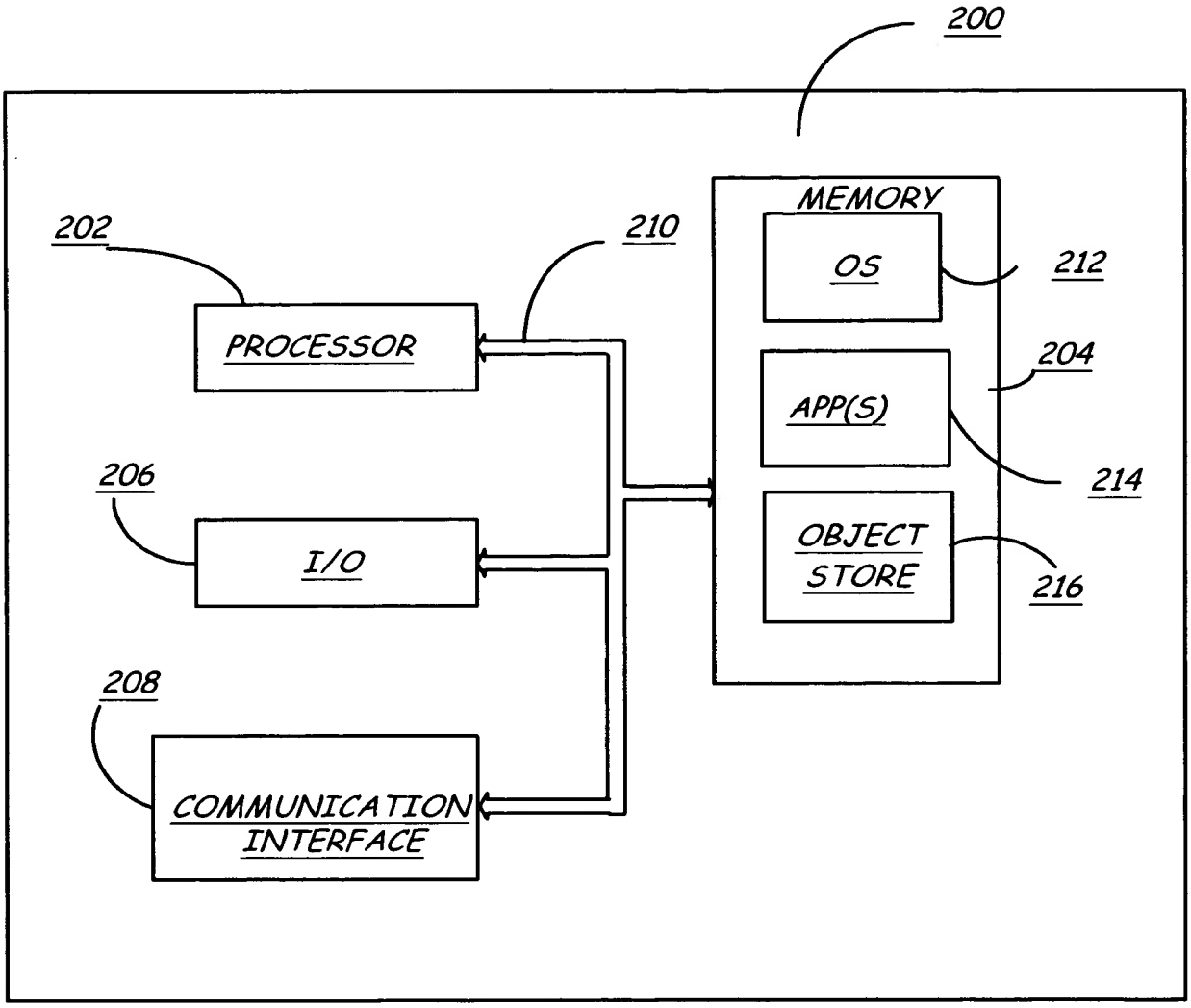

200
MEMORY
202
210
OS
212
PROCESSOR
204
APP(S)
214
206
I/O
OBJECT STORE
216
208
COMMUNICATION INTERFACE

FIG. 2

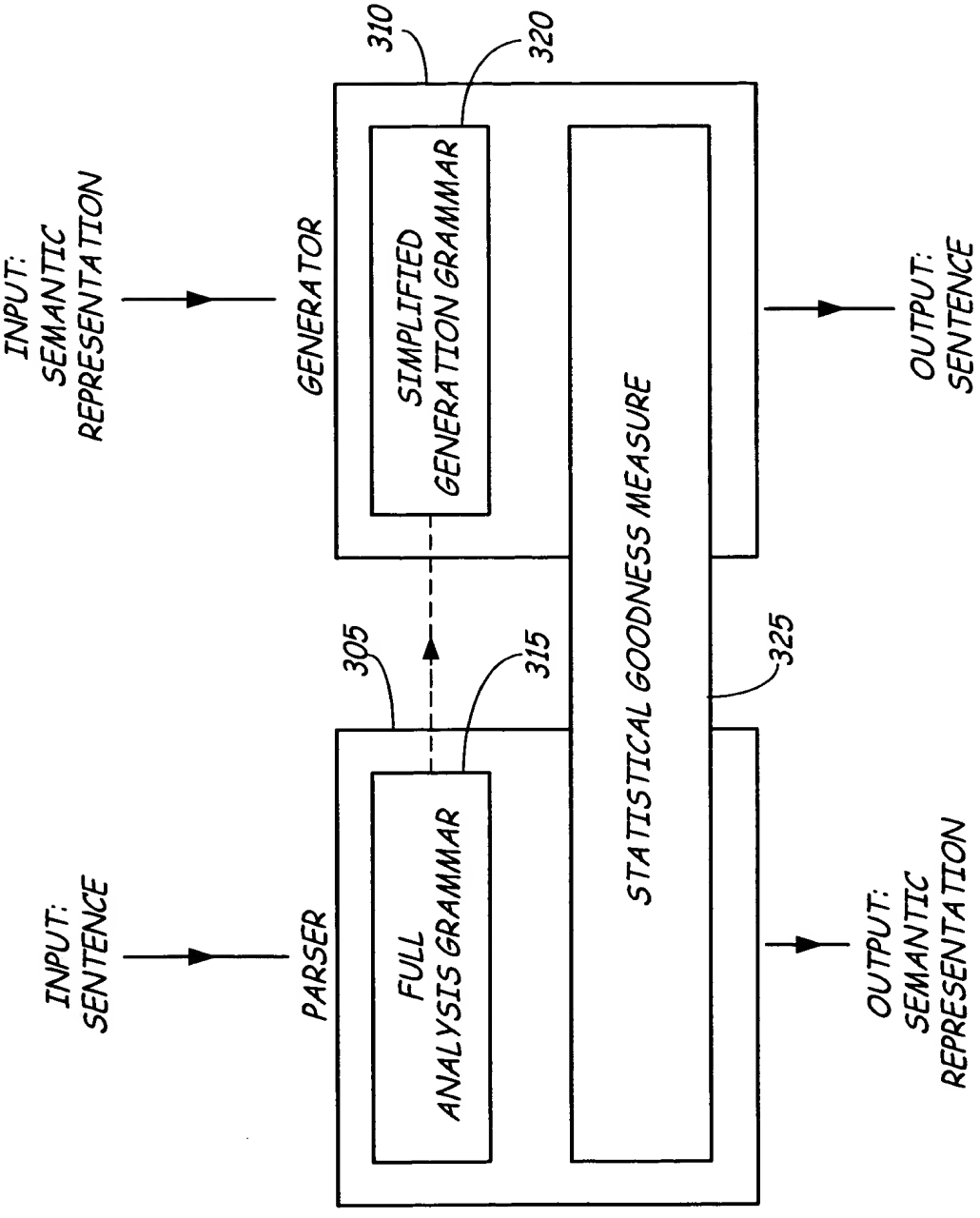

INPUT:
SEMANTIC
REPRESENTATION
GENERATOR
310
320
SIMPLIFIED
GENERATION GRAMMAR
OUTPUT:
SENTENCE
STATISTICAL GOODNESS MEASURE
325
305
315
INPUT:
SENTENCE
PARSER
FULL
ANALYSIS GRAMMAR
OUTPUT:
SEMANTIC
REPRESENTATION

FIG. 3

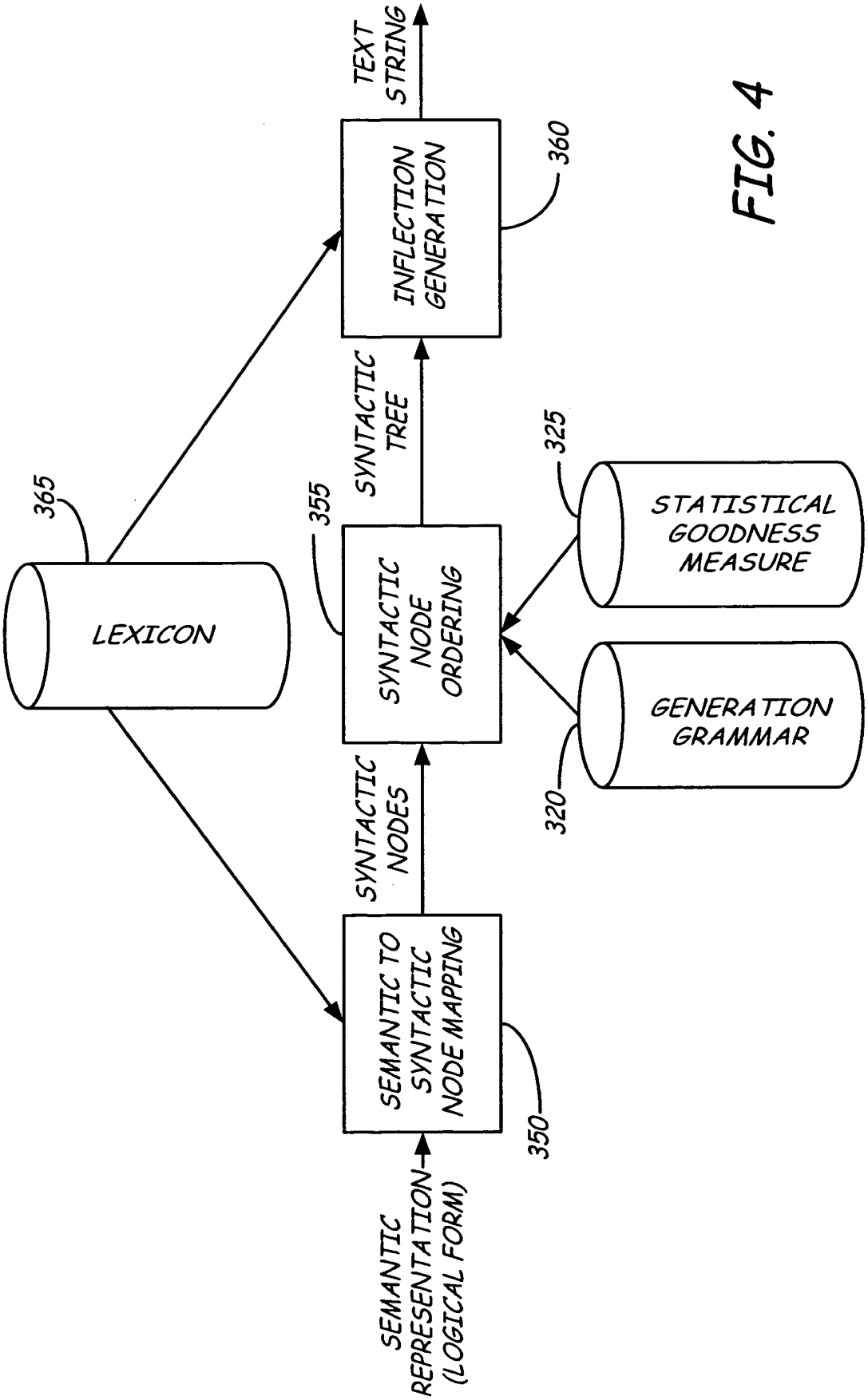

SEMANTIC REPRESENTATION (LOGICAL FORM)
SEMANTIC TO SYNTACTIC NODE MAPPING
350
SYNTACTIC NODES
SYNTACTIC NODE ORDERING
355
SYNTACTIC TREE
INFLECTION GENERATION
360
TEXT STRING
LEXICON
365
GENERATION GRAMMAR
320
STATISTICAL GOODNESS MEASURE
325

FIG. 4

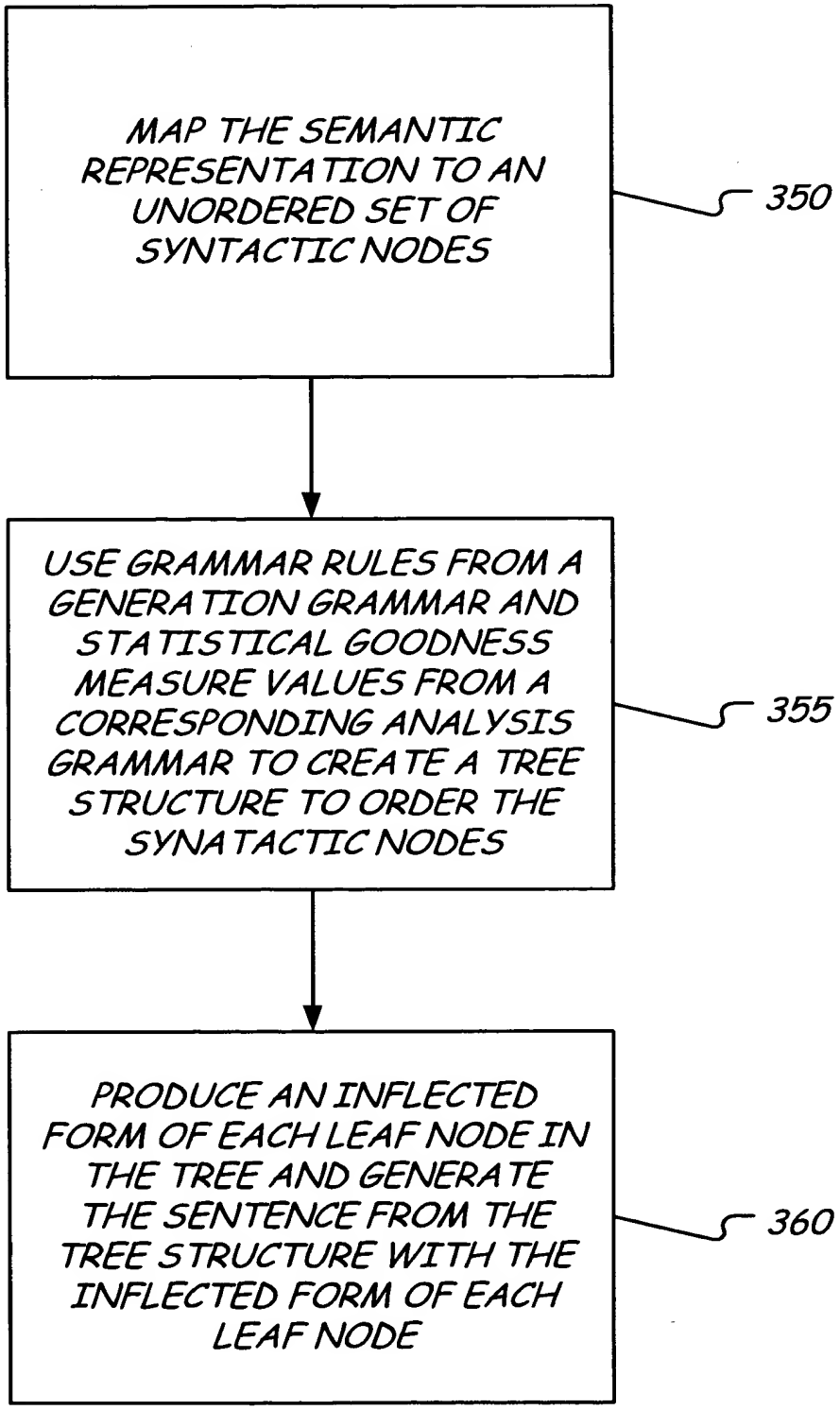

MAP THE SEMANTIC REPRESENTATION TO AN UNORDERED SET OF SYNTACTIC NODES
350
USE GRAMMAR RULES FROM A GENERATION GRAMMAR AND STATISTICAL GOODNESS MEASURE VALUES FROM A CORRESPONDING ANALYSIS GRAMMAR TO CREATE A TREE STRUCTURE TO ORDER THE SYNATACTIC NODES
355
PRODUCE AN INFLECTED FORM OF EACH LEAF NODE IN THE TREE AND GENERATE THE SENTENCE FROM THE TREE STRUCTURE WITH THE INFLECTED FORM OF EACH LEAF NODE
360

FIG. 5

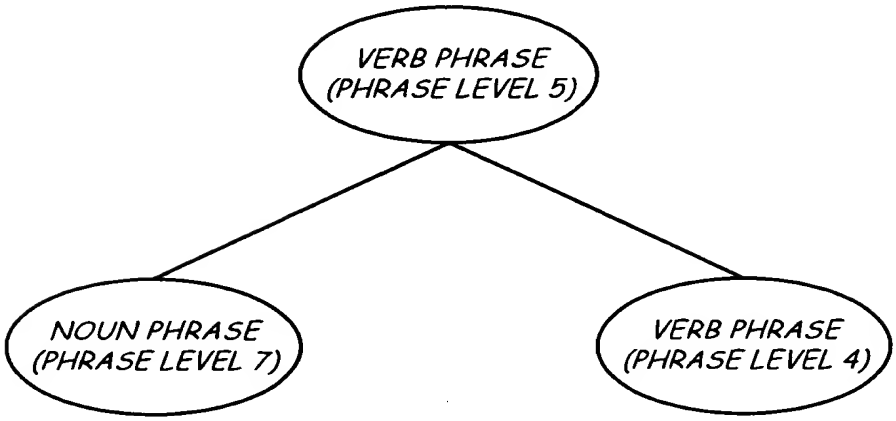


FIG. 6

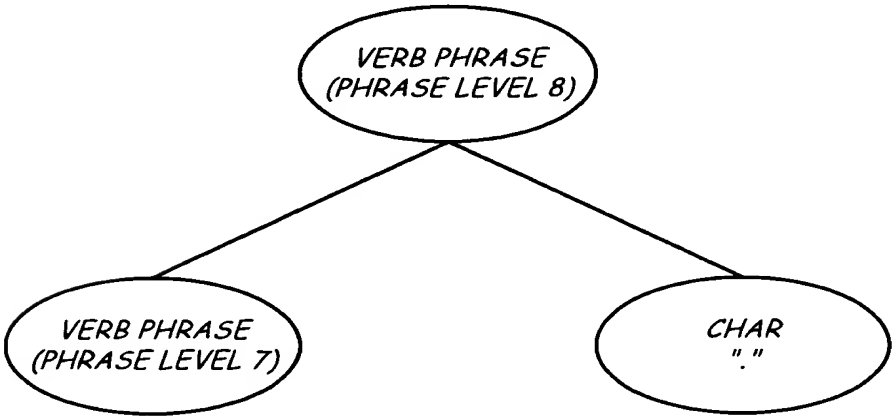


FIG. 8

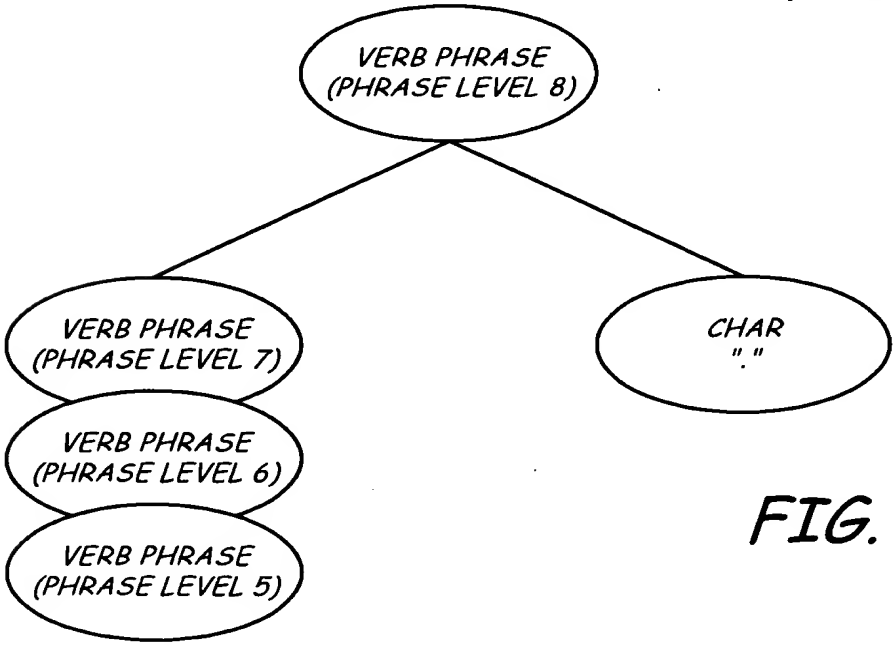


FIG. 9

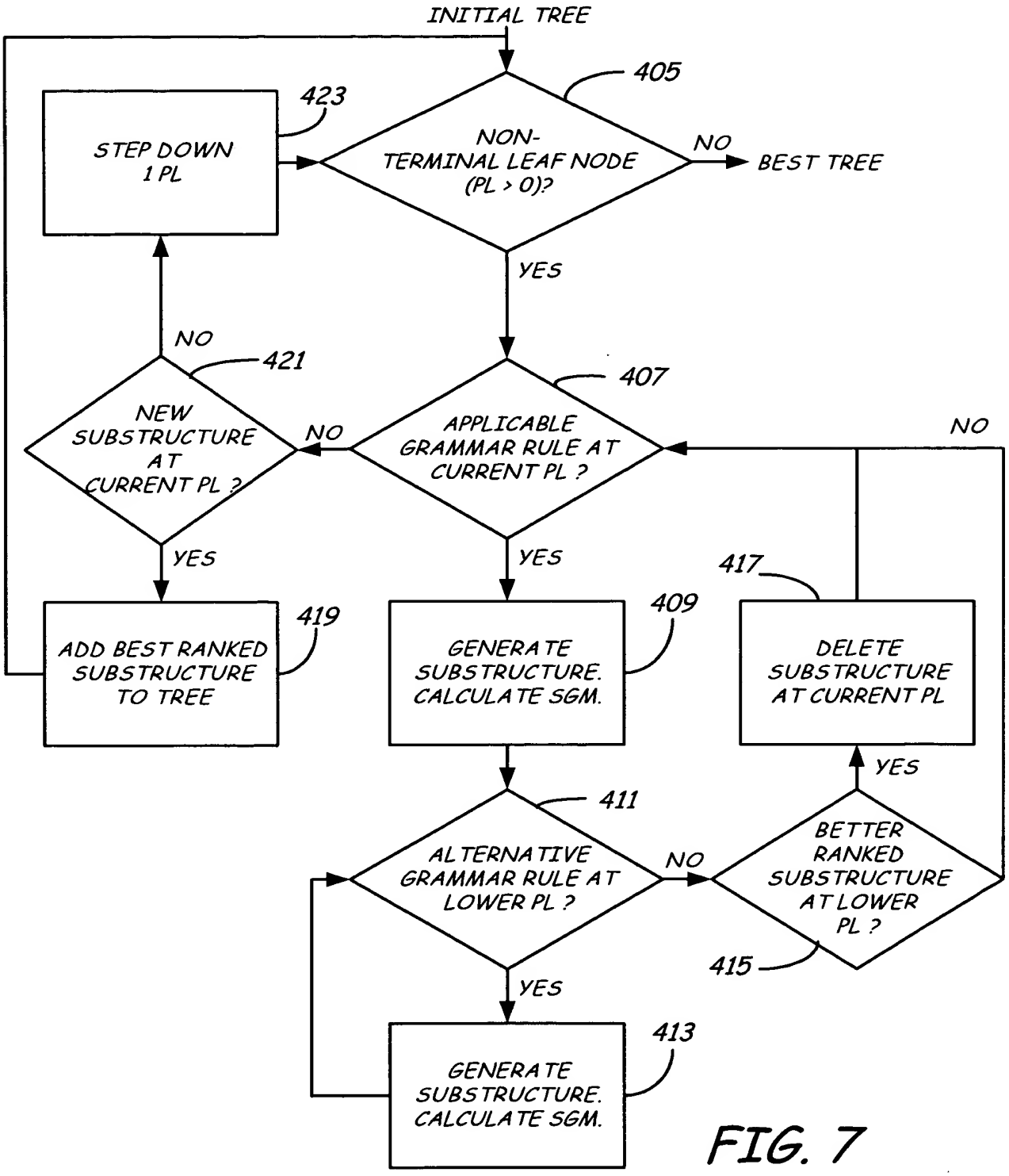

INITIAL TREE
405
423
STEP DOWN 1 PL
NON-TERMINAL LEAF NODE (PL > 0)?
NO
BEST TREE
YES
NO
421
407
NEW SUBSTRUCTURE AT CURRENT PL ?
NO
APPLICABLE GRAMMAR RULE AT CURRENT PL ?
NO
YES
YES
417
419
409
ADD BEST RANKED SUBSTRUCTURE TO TREE
GENERATE SUBSTRUCTURE. CALCULATE SGM.
DELETE SUBSTRUCTURE AT CURRENT PL
YES
411
ALTERNATIVE GRAMMAR RULE AT LOWER PL ?
NO
BETTER RANKED SUBSTRUCTURE AT LOWER PL ?
415
YES
413
GENERATE SUBSTRUCTURE. CALCULATE SGM.

FIG. 7

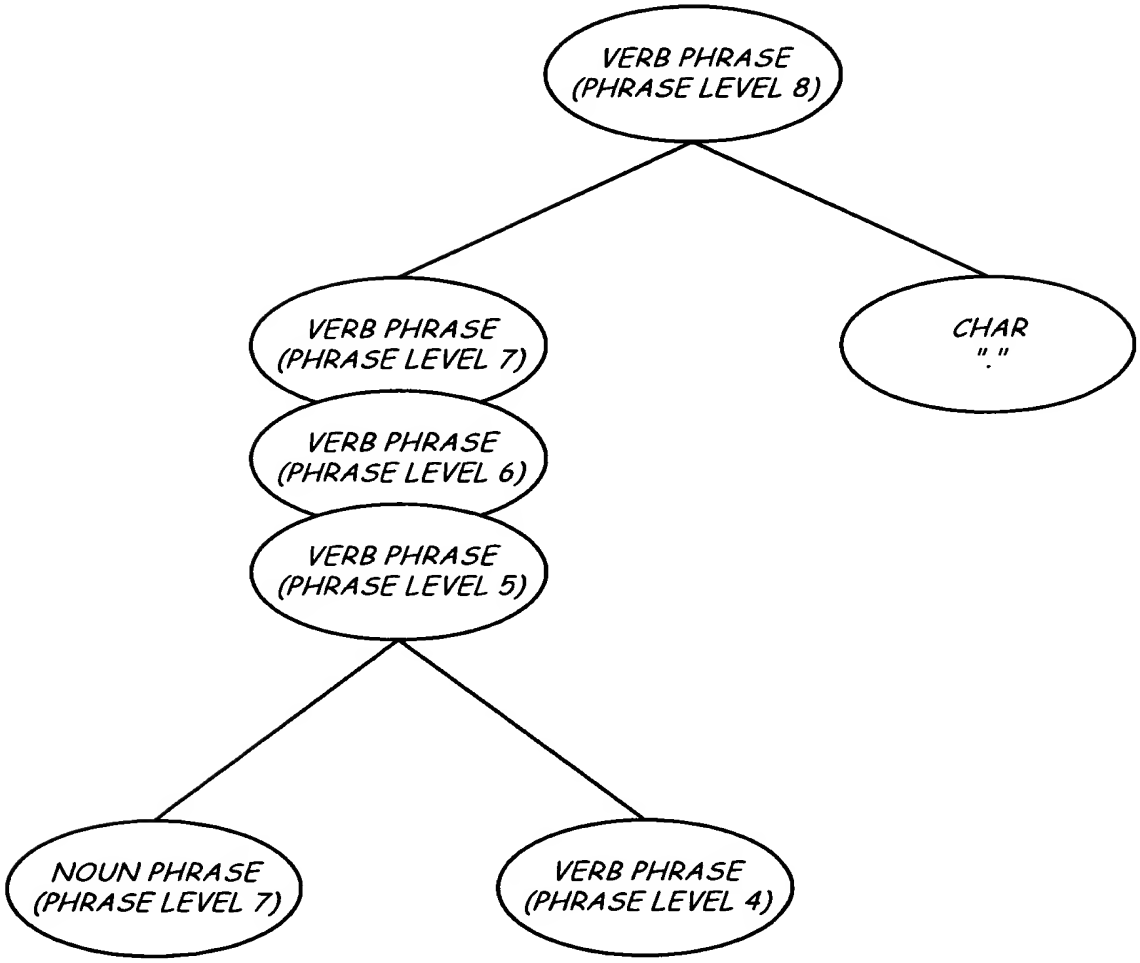

VERB PHRASE
(PHRASE LEVEL 8)
VERB PHRASE
(PHRASE LEVEL 7)
CHAR
"."
VERB PHRASE
(PHRASE LEVEL 6)
VERB PHRASE
(PHRASE LEVEL 5)
NOUN PHRASE
(PHRASE LEVEL 7)
VERB PHRASE
(PHRASE LEVEL 4)

FIG. 10

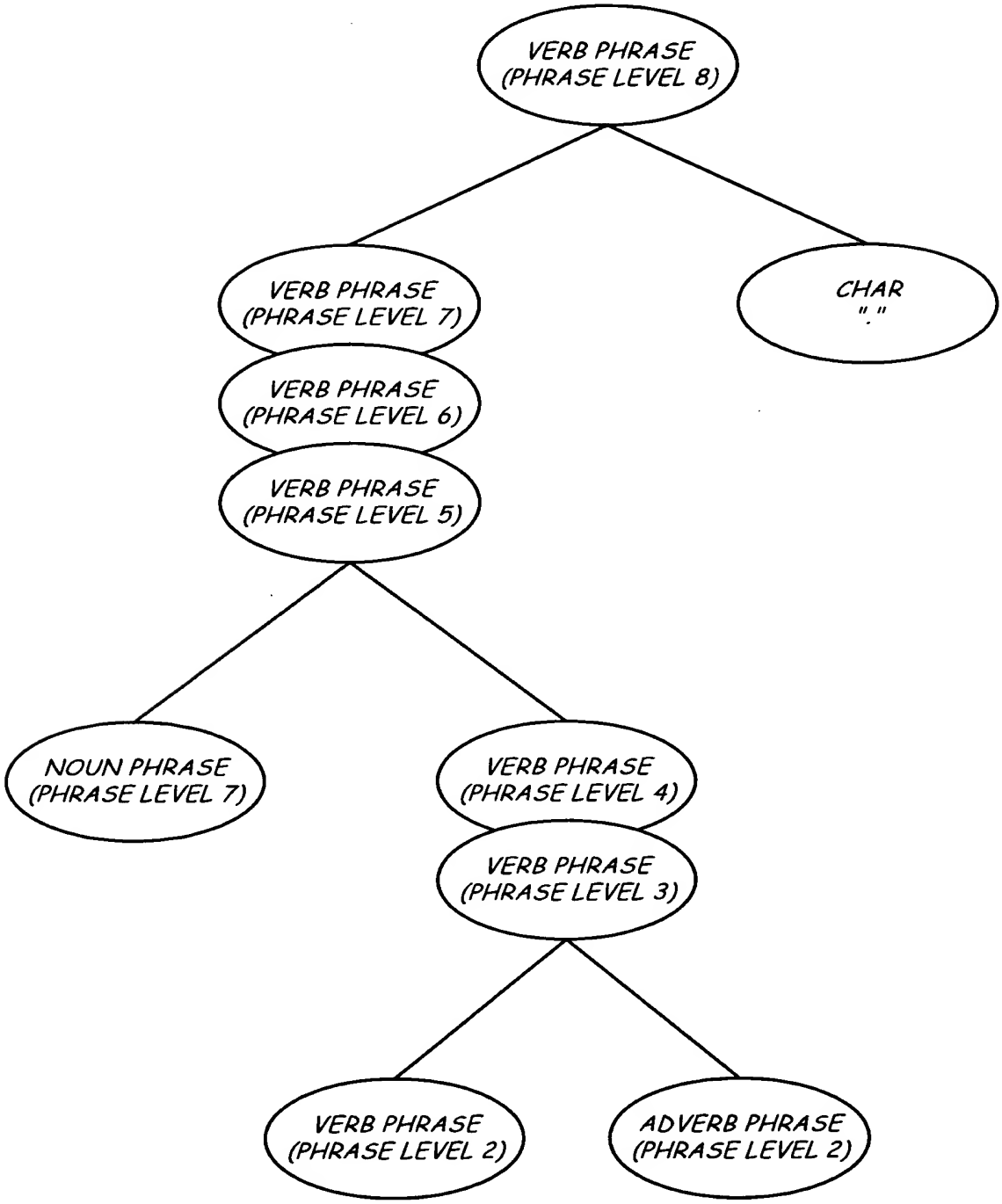
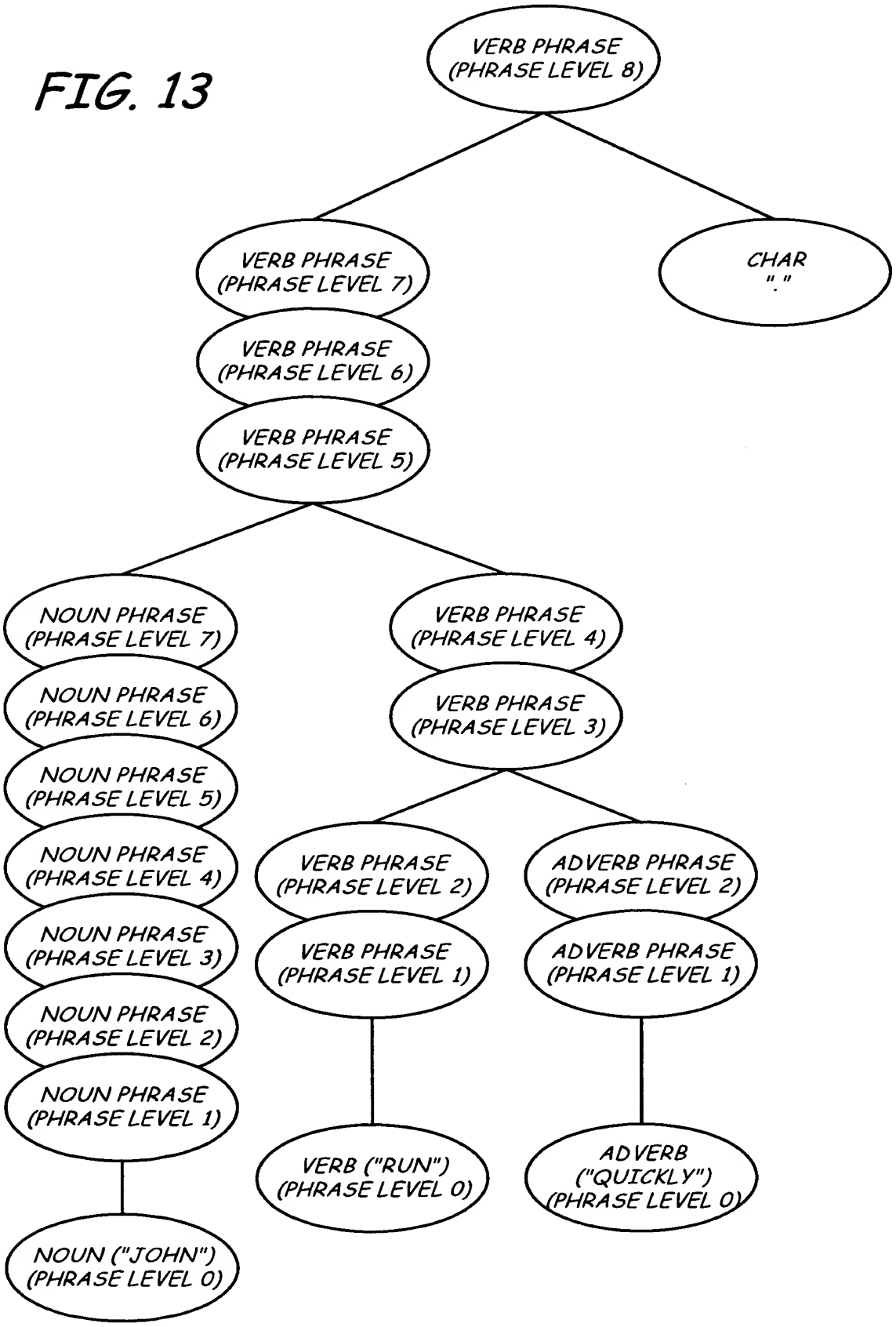

VERB PHRASE
(PHRASE LEVEL 8)
VERB PHRASE
(PHRASE LEVEL 7)
CHAR
"."
VERB PHRASE
(PHRASE LEVEL 6)
VERB PHRASE
(PHRASE LEVEL 5)
NOUN PHRASE
(PHRASE LEVEL 7)
VERB PHRASE
(PHRASE LEVEL 4)
VERB PHRASE
(PHRASE LEVEL 3)
VERB PHRASE
(PHRASE LEVEL 2)
ADVERB PHRASE
(PHRASE LEVEL 2)

FIG. 11

VERB PHRASE (PHRASE LEVEL 8)
VERB PHRASE (PHRASE LEVEL 7)
CHAR "."
VERB PHRASE (PHRASE LEVEL 6)
VERB PHRASE (PHRASE LEVEL 5)
NOUN PHRASE (PHRASE LEVEL 7)
VERB PHRASE (PHRASE LEVEL 4)
VERB PHRASE (PHRASE LEVEL 3)
VERB PHRASE (PHRASE LEVEL 2)
ADVERB PHRASE (PHRASE LEVEL 2)
VERB PHRASE (PHRASE LEVEL 1)
VERB ("RUN") (PHRASE LEVEL 0)

FIG. 12

FIG. 13


VERB PHRASE (PHRASE LEVEL 8)
VERB PHRASE (PHRASE LEVEL 7)
CHAR "."
VERB PHRASE (PHRASE LEVEL 6)
VERB PHRASE (PHRASE LEVEL 5)
NOUN PHRASE (PHRASE LEVEL 7)
VERB PHRASE (PHRASE LEVEL 4)
NOUN PHRASE (PHRASE LEVEL 6)
VERB PHRASE (PHRASE LEVEL 3)
NOUN PHRASE (PHRASE LEVEL 5)
NOUN PHRASE (PHRASE LEVEL 4)
VERB PHRASE (PHRASE LEVEL 2)
ADVERB PHRASE (PHRASE LEVEL 2)
NOUN PHRASE (PHRASE LEVEL 3)
VERB PHRASE (PHRASE LEVEL 1)
ADVERB PHRASE (PHRASE LEVEL 1)
NOUN PHRASE (PHRASE LEVEL 2)
NOUN PHRASE (PHRASE LEVEL 1)
VERB ("RUN") (PHRASE LEVEL 0)
ADVERB ("QUICKLY") (PHRASE LEVEL 0)
NOUN ("JOHN") (PHRASE LEVEL 0)

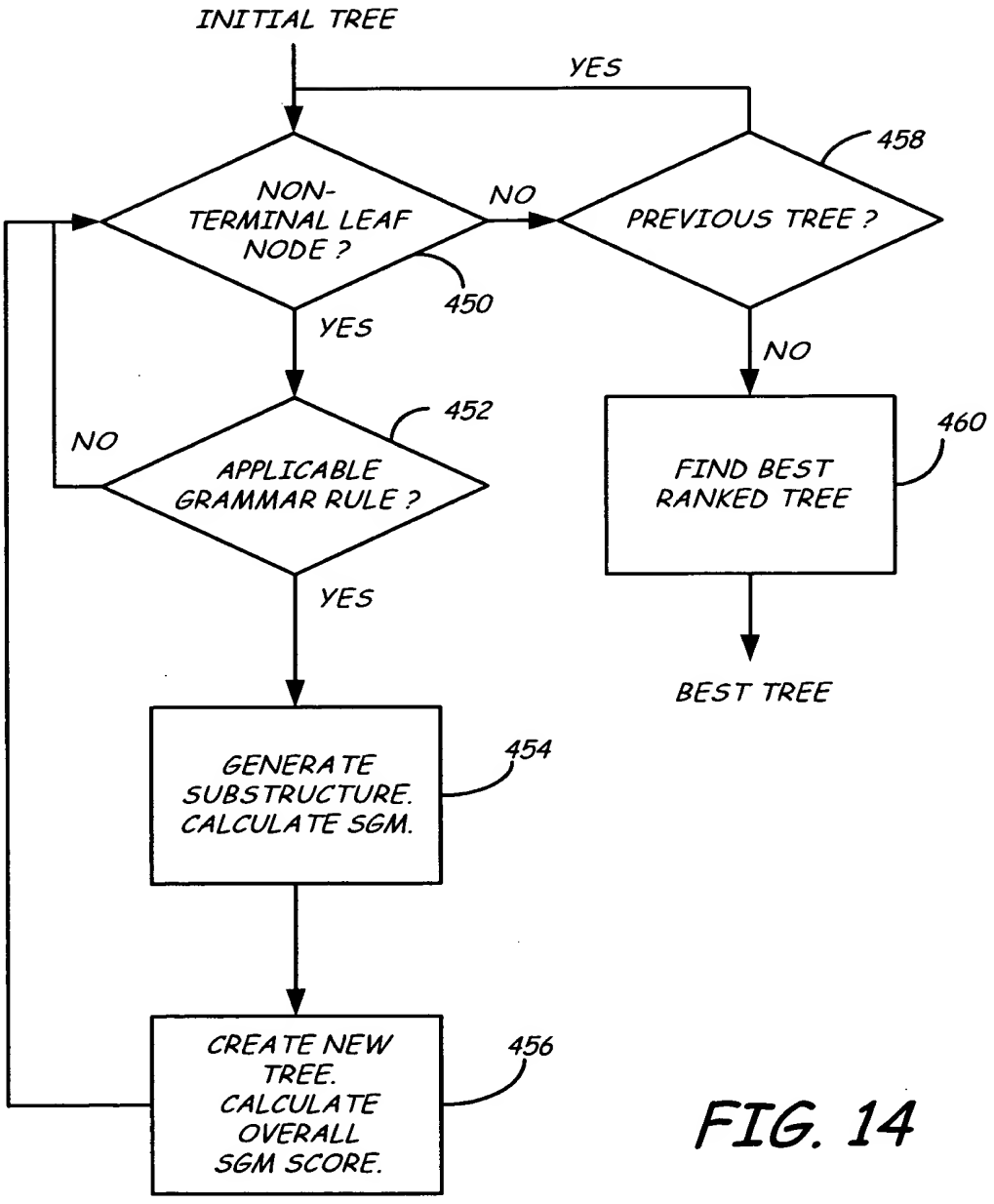

INITIAL TREE
YES
NON-TERMINAL LEAF NODE ?
NO
PREVIOUS TREE ?
458
450
YES
NO
NO
APPLICABLE GRAMMAR RULE ?
452
FIND BEST RANKED TREE
460
YES
BEST TREE
GENERATE SUBSTRUCTURE. CALCULATE SGM.
454
CREATE NEW TREE. CALCULATE OVERALL SGM SCORE.
456

FIG. 14

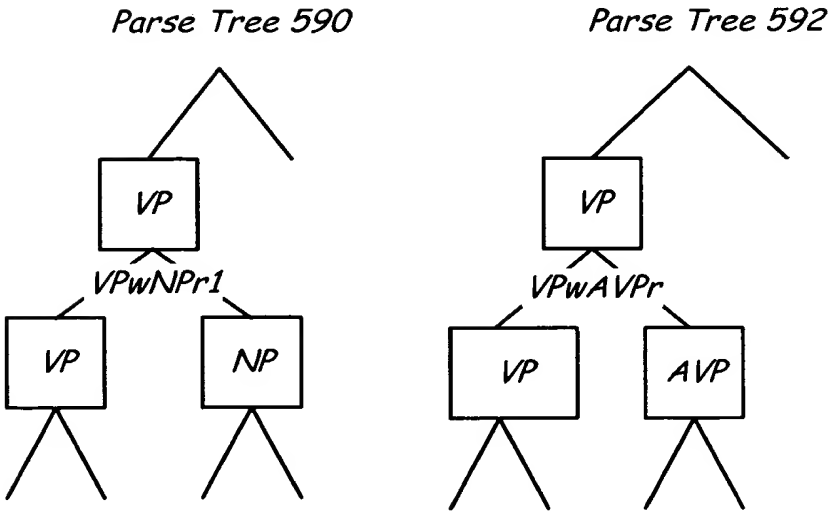


FIG. 15A

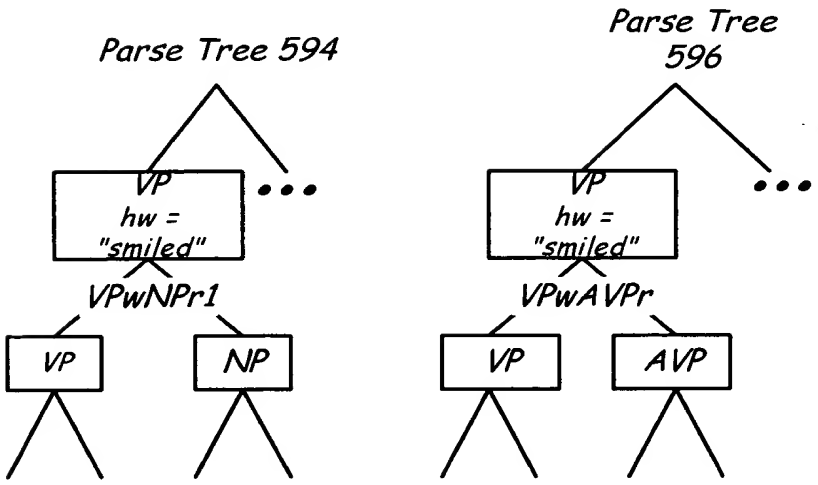


FIG. 15B

Rule Name	Rule				Description (and an example)
VERBtoVP	VP	→	VERB		Promote a verb into a verb phrase
PredAdj	VP	→	VP	AJP	Add on an adjective. *"It has been found effective"*
VPwNPr1	VP	→	VP	NP	Add direct object to a VP *"I hit Bill"*
Perfect	VP	→	VP	VP	Adds the VP "have" to a VP *"Joe had gone"*
SubjPQuant	VP	→	NP	VP	Add quantifiers to the VP like "all", "both", ... *"The children have all gone"*
VPwNP1	VP	→	NP	VP	Add noun subject to a VP *"John jumped."*
SubjectAJP	VP	→	AJP	VP	Add AJP subject to a VP *"More surprising is his attitude"*
InvertAJPwS	VP	→	AJP	VP	Add final modifier, AJP, to the left of a VP *"More remarkable still, he went"*
Topicalization	VP	→	NP	VP	Add object of VP, NP, to the left of a VP *"A better-looking man I have not seen"*

FIG. 16

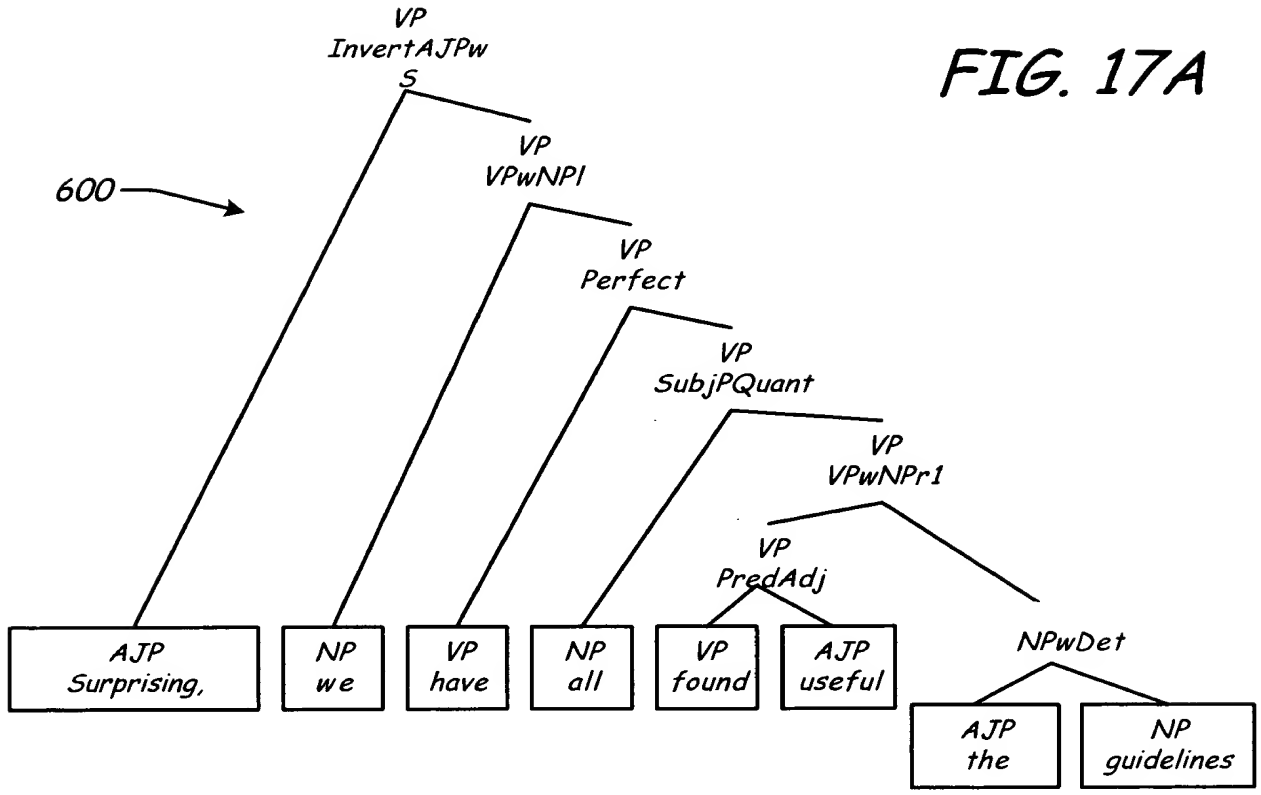


FIG. 17A

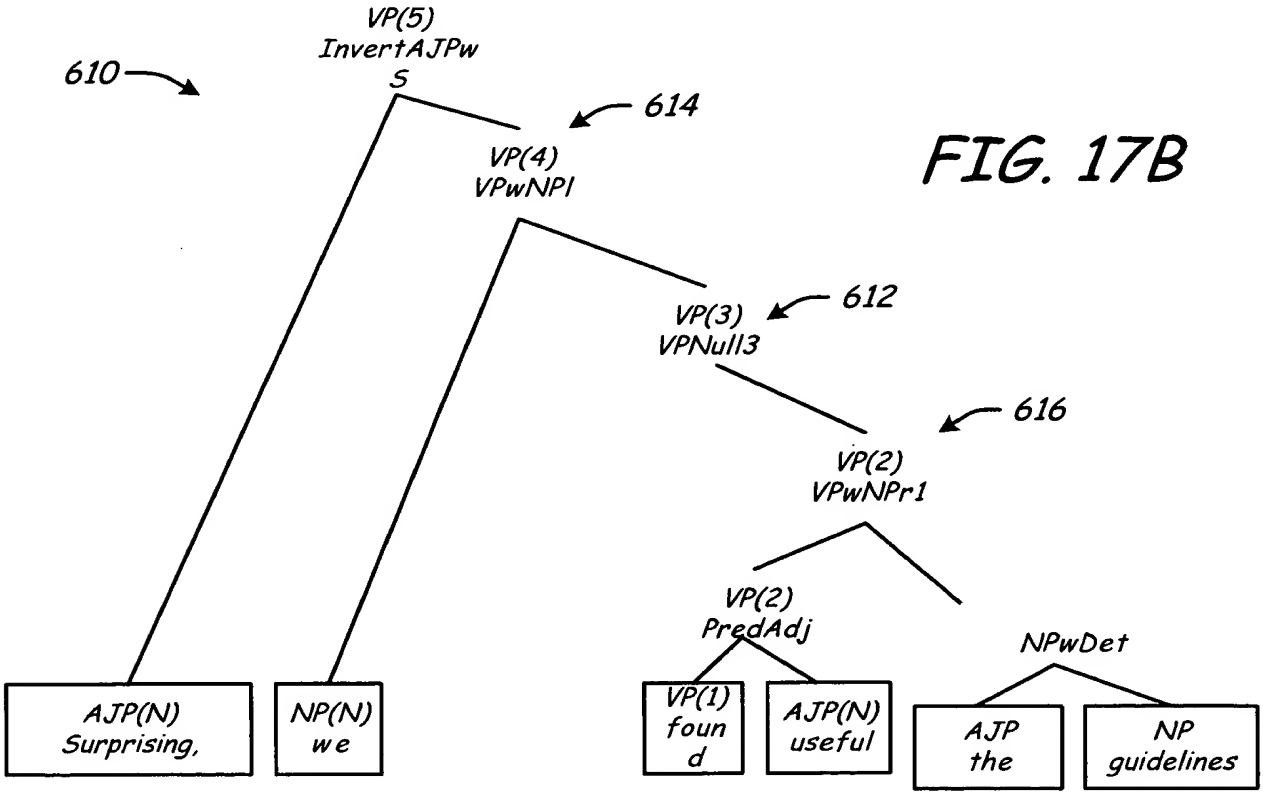


FIG. 17B

Phrase Level	Rule Name	Rule			Level Description
1	VERBtoVP	VP(1) →	VERB(PL_Verb_Max)		Create a VP
2	PredAdj	VP(2) →	VP(1)	AJP(PL_AJP_Max)	Add post modifiers
	VPwNPr1	VP(2) →	VP(1)	NP(PL_AJP_Max)	
	VPNull2	VP(2) →	VP(1)		
3	Perfect	VP(3) →	VP(1)	VP(2,3)	Add "have" and quantifiers
	SubjPQuant	VP(3) →	NP(PL_NP_Max)	VP(2,3)	
	VPNull3	VP(3) →	VP(2)		
4	VPwNPl	VP(4) →	NP(PL_NP_Max)	VP(3)	Add subject
	SubjectAJP	VP(4) →	AJP(PL_AJP_Max)	VP(3)	
	VPNull4	VP(4) →	VP(3)		
5	InvertAJPwS	VP(5) →	AJP(PL_AJP_Max)	VP(4)	Add modifiers to VPs that have a subject
	Topicalization	VP(5) →	NP(PL_NP_Max)	VP(4)	
	VPNull5	VP(5) →	VP(4)		

FIG. 18

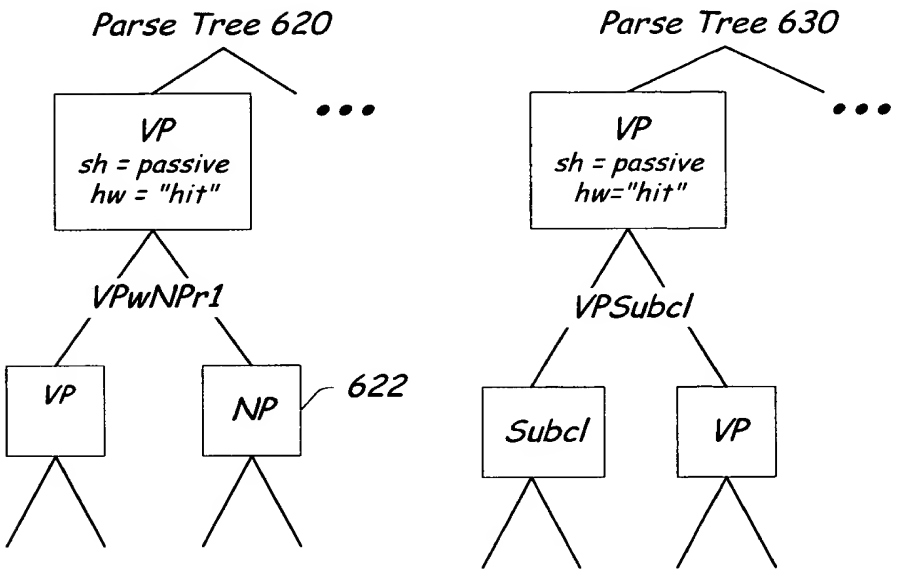

Parse Tree 620
VP
sh = passive
hw = "hit"
VPwNPr1
VP
NP
622
Parse Tree 630
VP
sh = passive
hw="hit"
VPSubcl
Subcl
VP

FIG. 19

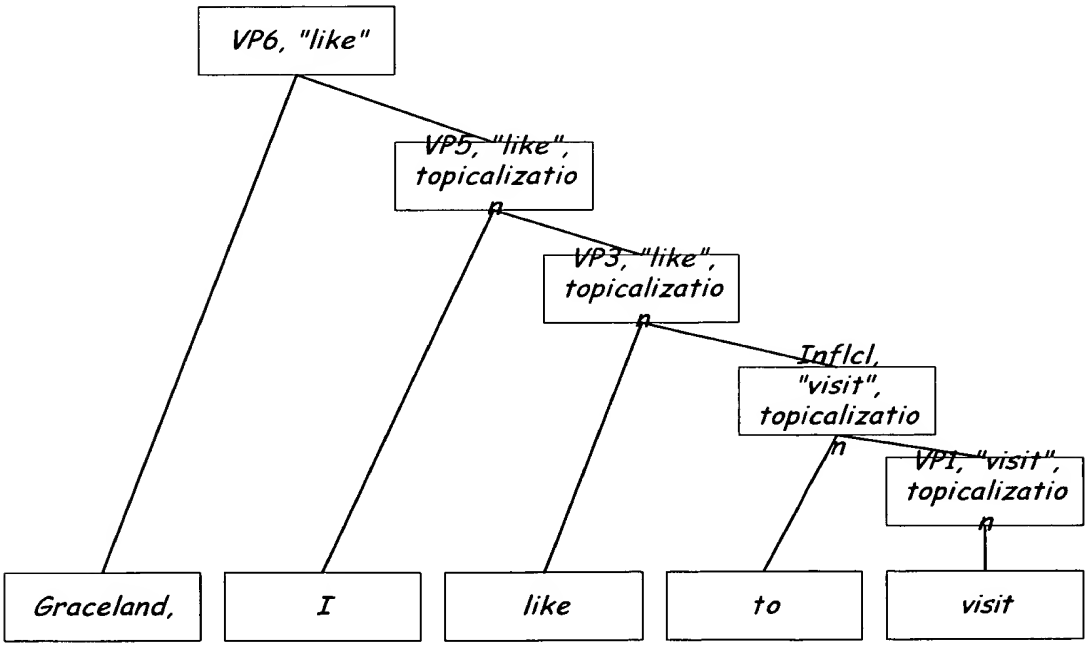

VP6, "like"
VP5, "like", topicalizatio n
VP3, "like", topicalizatio n
InflCl, "visit", topicalizatio n
VP1, "visit", topicalizatio n
Graceland,
I
like
to
visit

FIG. 20

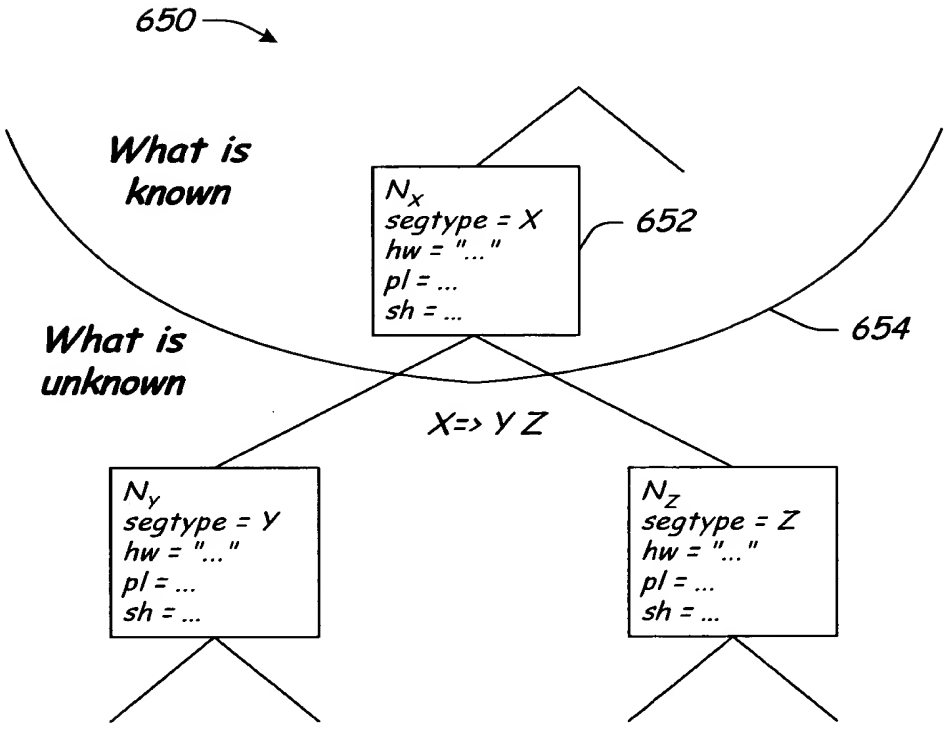

650
What is known
What is unknown
N_X
segtype = X
hw = "..."
pl = ...
sh = ...
652
654
X=> Y Z
N_Y
segtype = Y
hw = "..."
pl = ...
sh = ...
N_Z
segtype = Z
hw = "..."
pl = ...
sh = ...

FIG. 21